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(71) Applicant: BAKER HUGHES INCORPORATED
Houston Texas 77210-4740 (US)

(72) Inventors:
- Fincher, Roger
Conroe, Texas 77302 (US)
- Watkins, Larry
Houston, Texas 77065-3230 (US)
- Makohl, Friedhelm
29320 Hermannsburg (DE)
- Hahn, Detlef
30657 Hannover (DE)

(74) Representative: Jeffrey, Philip Michael
Frank B. Dehn & Co.
179 Queen Victoria Street
London EC4V 4EL (GB)

(54) Drilling liner systems

(57) A drilling liner having a core bit (24) at its bottom end is carried along with a pilot bit (26) on an inner bottom hole assembly driven by a downhole mud motor (40). In one embodiment, the motor is powered by mud carried by an inner string (fig. 5). Alternatively, the inner string may be omitted and the flow of mud through the liner (22) powers the motor (40): this requires a locking tool for locking the motor assembly to the outer assembly. Once an abnormally (high or low) pressured zone has been traversed, the liner (22) is set as a casing, the inner assembly is pulled out, and drilling may be resumed using a conventional tool. Directional drilling is accomplished by having an MWD device (430) for providing directional information and having directional devices on the inner and outer assembly. These include retractable steering pads (438). Expandable bits (726), under-reamers (63) and jetting nozzles may also be used in the drilling process. One embodiment of the invention has a bottom thruster (869) between the mud motor (859) and the drill bits (724,726) that makes it possible to continue drilling for a limited distance even if the upper portion of the casing is stuck.

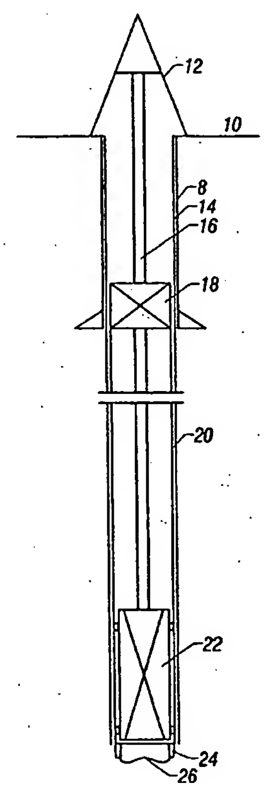

FIG. 1

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Description

[0001] The invention relates to a method of and an apparatus for drilling a borehole in underground formations with at least one formation that has a significantly different formation pressure than an adjacent formation or where time dependent unstable formations do not allow sufficient time to case off the hole in a subsequent run.

[0002] A collapsed hole adds great expense to the drilling of a wellbore and can lead to the abandonment of the hole. Hole collapse can be caused by a number of drilling conditions including shale swelling, sloughing, and unconsolidated sands that cause a hole to wash out or collapse as soon as it is drilled. In these unstable formations, the bore hole can not be cased off and protected in time, when running a liner in a subsequent run after the hole was drilled.

[0003] Another cause of wellbore/hole collapse is an extreme pressure drop between adjoining formations. Drilling into a low pressure formation with a heavy mud that is designed to drill through an overlying high pressure zone will result in severe mud losses and simultaneous hole collapse. An opposite situation is encountered when a borehole is drilled through a first formation having a low formation pressure into a formation of substantially higher formation pressure, then there is the danger of fluids from the lower formation entering the borehole and damaging the upper formation. If the pressure difference is large enough, there is a risk of a blowout. If the mud weight is increased to prevent such a blowout, then the mud can damage the low pressure formation.

[0004] There is a need for an apparatus and method of drilling boreholes that avoids these problems. Such an invention should preferably reduce the operational time in its use. It should preferably be adaptable for use with directional drilling systems. It should reduce the exposure of the formations to the dynamic circulation pressure of the drilling mud and thereby reduce formation damage. A further desirable aspect is ro reduce the likelihood of getting stuck in the borehole. In addition, if the apparatus does get stuck, it should be possible to continue drilling ahead. The present invention satisfies this need.

[0005] The present invention is an apparatus and method for drilling through formations in which the pressure is significantly different from the pressure in the adjacent formations, and/or unstable formations make it difficult to protect the formation with a liner or casing in the hole. The drilling liner system consists of an inner string carrying an inner assembly having a pilot bit, and an outer assembly having a core bit. Both assemblies are temporarily connected via retractable splines that ensure that the inner and outer assemblies are properly aligned with each other. When running in the hole, the splines are retracted and, upon reaching the proper alignment, extend automatically. After the liner is set, the process of pulling the inner string from the liner forces the splines to retract once again. One embodiment of the invention is a system in which there is no inner string between the bottom hole assembly and the liner hanger. Besides eliminating the trip time for the inner string, this makes it possible to fish the bottom hole assembly out of the hole with a jointed pipe or a wireline. Another embodiment of the invention has a steerable drilling liner, the steering being accomplished by a tilted joint, or with steering pads. Another embodiment of the invention has a sealed annulus between the open hole and the liner. This isolates the open hole from the dynamic pressure of the circulating mud system. Yet another embodiment of the invention incorporates a reamer on the outer part of the liner to enlarge the hole and thereby reduce the risk of getting stuck. An expandable core bit or pilot bit may be used to provide a similar result. Another embodiment of the invention makes it possible to do some additional drilling even after getting stuck. In another embodiment of the invention, high pressure jetting nozzles are used with the pilot bit to enlarge the hole and reduce the risk of getting stuck. Instead of drilling pipe, the drilling liner can be used with coiled tubing.

BRIEF DESCRIPTION OF THE FIGURES

[0006]

Fig. 1	shows an overall diagrammatic view of a drilling system with a drilling liner.
Figs. 2A, 2B	show details of the Drilling Liner Bottom Hole Assembly (DL-BHA).
Fig. 3	is a schematic illustration of a modified DL-BHA without an inner string.
Fig. 4	shows details of the releasing tool used in the DL-BHA of Fig. 3.
Fig. 5	is a schematic illustration of a system having a steerable drilling liner.
Fig. 6	is a schematic illustration of a system having a steerable drilling liner with steering pads on the liner.
Fig. 7	is a schematic illustration of a drilling liner that isolates the formation from dynamic pressure variations.
Fig. 8	is a schematic illustration of a drilling liner having an under-reamer.
Fig. 9	is a schematic illustration of a drilling liner having an expandable core-bit.
Fig. 10	is a schematic illustration of a bottom hole assembly having a thruster for continued drilling when the liner is stuck.
Fig. 11	illustrates a situation in which the pilot bit of the invention of Fig. 10 rotates without the liner being rotated.

[0007] United States Patent Application Ser. No. 08/729,226 filed on October 9, 1996, now United States

Patent No. ****** , the contents of which are fully incorporated here by reference, discusses an apparatus and method of drilling boreholes in underground formations in which the formation pressures differ considerably. The drilling liner system consists of an outer an inner assembly. Both assemblies are temporarily connected via retractable splines that ensure that the inner and outer assemblies are properly aligned with each other. When running in the hole, the splines are retracted and, upon reaching the proper alignment, extend automatically. After the liner is set, the process of pulling the inner string from the liner forces the splines to retract one again.

[0008] The inner assembly consists of a pilot bit, a male sub, a downhole motor and a thruster or other device to provide the necessary weight on bit. The inner assembly's spline male sub houses the retractable drive splines, which transmit torque from the motor to the outer assembly's core bit. This means that the pilot bit and the core bit turn together at the same rate. The motor provides torque and rotation while the thruster provides a dynamic length suspension of the inner string with respect to the outer string. This allows the thruster to compensate for differential thermal expansion between the inner and outer assemblies. Additionally, the thruster provides the hydraulic weight on bit (WOB).

[0009] The outer assembly includes a core head, a female sub, a suspension sub (bearing sub) and a landing sub. The outer, lower assembly is connected via a crossover to a standard liner with required length. In addition to delivering the cutting action, the core head provides guidance for the inner assembly's pilot bit. The spline female sub forms a locking mechanism for the inner assembly's retractable male splines. The suspension sub offers longitudinal length suspension and delivers radial guidance. Axial forces (WOB) are transmitted to the inner string. Even though no axial bearing is required in the suspension sub, it can be installed, if liner size and drift offered sufficient wall thickness. The suspension sub also ensures that only the core bit and the female sub turn. If required, the rest of the assembly rotates at a lower RPM set at the surface. A liner hanger and running tool connect the inner and outer assemblies in the drilling mode. Following drilling, the liner hanger is set before the running tool is disconnected from the liner and the packer is set before the inner string is pulled out of the hole. The running tool which connects liner and the inner string is usually a part of the liner hanger. If using a single running tool, liner hanger and packer might not necessarily be required and the need for the liner hanger/packer will depend on the application. In the following discussion, embodiments of the invention are shown using a liner hanger, but it is to be understood that it may not be necessary in all cases. During drilling operations, drilling mud emerges from the end of the drill bit and passes into the bore hole so that it can subsequently flow back to the surface through the annular space between the drilling tool and the walls of the bore hole.

[0010] **Fig. 1** shows a schematic illustration of an embodiment of the present invention for drilling a borehole using a drilling liner. Shown is a rig **12** at the surface **10** of the earth in which a borehole **8** is drilled. A casing **14** has been set in the upper portion of the borehole. A drilling tubular **16** passes through the casing to a liner hanger/packer **18** at the bottom of the cased portion of the hole and carries a drilling liner - bottom hole assembly (DL-BHA) **22** at its lower end. The DL-BHA has, at its bottom end, a pilot bit **26** and a core bit **24**. A liner **20** hangs from the liner hanger **18** at its top end is connected to the DL-BHA at its bottom end. The drilling tubular may be a drill pipe or coiled tubing.

[0011] The liner hanger **18** connects the inner string, the outer line assembly and the drill pipe running string for the drilling mode. After completion of drilling, the liner hanger is set and the running tool disconnects from the liner. Desirable features for the liner hanger are:

(i) Quick and reliable hydraulic setting function that is insensitive to circulating pressure while drilling
(ii) Releasing function that is independent of the setting function.
(iii) All hanger sealing components suitable for handling extreme external pressure differentials resulting from internal pipe evacuation.
(iv) Capability to circulate through the inner string (discussed below) after releasing from the liner.
(v) Capability to run wireline perforators or back off tools below the hanger to allow fishing in case the inner string becomes stuck.
(vi) Capability to allow surface rotation and sufficient torque resistance.

[0012] Details of the DL-BHA are shown in **FIGS 2A** and **2B**. Shown at the top of **FIG. 2A** is a drilling tubular **16** to the surface and the liner hanger **18**. The drilling tubular **16'** below the liner hanger **18** may be of a smaller size than above the liner hanger **18**. A thruster **34** is connected to the drilling tubular **16'** and a drilling collar **16"** connects the thruster **34** to the drilling liner inner assembly **30** while the liner **20** is connected to the drilling liner outer assembly **32.**

[0013] The drilling liner inner assembly **30** includes a drilling motor **40**, the pilot bit **24**, and a male sub **54** with drive splines **52** that transmit the torque from the motor **40** to the outer assembly. Landing splines **44** ensure a proper alignment of the inner assembly to the outer assembly. The outer assembly **32** includes the core bit **24**, a landing sub **46**, a suspension and bearing sub **48** and a female sub **50** that engages the drive splines **52**. The suspension and bearing sub **48** provides longitudinal length suspension and radial guidance and ensure that only the female sub **50** and the core bit **26** turn and the rest of the outer assembly remains without rotation.

[0014] The downhole motor **40** provides the cutting torque and rotation. The thruster **34** provides a hydraulic

weight on bit (WOB) and a dynamic length suspension.

[0015] As discussed in United States Patent Application Ser. No. 08/729,226, a standard drilling BHA is used to drill to the vicinity of a potential problem zone without the liner. The standard BHA is retrieved and the drilling liner is run in hole to continue further drilling through the problem zone. Once the problem zone has been traversed, the liner is set and the inner string is retrieved. Drilling may then continue below the problem zone and if a second problem zone is encountered, the process may be repeated.

[0016] **FIG. 3** shows a schematic illustration of a drilling liner system without the use of an inner string between the liner hanger and the DL-BHA motor. This eliminates the additional weight of the inner string to be carried by the rig. Furthermore it reduces the frictional forces between liner and hole when drilling in highly deviated hole sections. The maximum drilling distance in this kind of wells can be quite large. Shown is a rig **112** at the surface **110** of the earth in which a borehole **108** is drilled. A casing **114** has been set in the upper portion of the borehole. A drilling tubular **116** passes through the casing to a liner hanger **118** at the bottom of the cased portion of the hole. A liner **120** hangs from the liner hanger **118** at its top end is connected to the DL-BHA **122** at its bottom end. The DL-BHA has, at its bottom end, a pilot bit **126** and a core bit **124**. These are as discussed above with reference to **FIG. 1**.

[0017] A landing sub is not necessary because the DL-BHA **122** is temporarily connected to the lower part of the liner **120** by means of a releasing tool **128**. An inner string between the liner hanger **118** and the DL-BHA **122** is not required. The top of the releasing tool is provided with a fishable joint **130** that makes it possible to fish the DL-BHA **122** after the liner hanger/packer **118** is set.

[0018] **FIG. 4** shows details of the DL-BHA with releasing tool **128**. The BHA is connected to the Liner as shown in Figure 3 using the upper liner connection **164**. In contrast to the assembly discussed in **Fig. 2**, instead of the landing sub a cross over sub **175** is used to connect the outer part of the releasing tool to the outer portion of the lower drilling liner. The BHA has on it's bottom end a pilot bit **124**, core bit **126**, female sub **50**, male sub **54**, drive splines **52** and a downhole motor **40** as discussed under **Fig. 1**. Instead of a motor with special bearing housing (featuring the landing splines), a standard available downhole motor can be used. The motor features a screw on stabilizer **176** for centralization of the inner string inside the outer string.

[0019] **Fig. 4A** shows details of the releasing tool. *Instead of the shown Releasing Tool also standard components like e.g. a Baker Oil Tools sealing sub and running tool can be used.* The preferred embodiment of the releasing tool combines the releasing mechanism and the sealing features in one single tool assembly to reduce the total length of the BHA. This makes it possible to pre-assemble the BHA offsite and send to the rig side as a single component.

[0020] The releasing tool as shown under **Fig. 4a** features an outer string, which will stay in hole, and the inner string, which will be tripped out of hole after the liner is set. The inner string and the outer string are temporarily connected by means of the locking splines **162**. Variations in length due to temperature changes, and errors in manufacturing tolerances, are compensated for by the axial stroke of the suspension ub **48**. The outer string includes the top sub **161** with the upper liner connection **164**, the locking sub **173** and the cross over sub **175**. The cross over sub **175** is connected to the lower outer Drilling Liner BHA. The inner string constituting the retrievable parts comprises of the pulling sleeve **171** including a fishable joint **160**, the stop sleeve **174**, the optional seal carrier **168**, locking splines **162**, a first mandrel **169** and a second mandrel **170**. The second mandrel **170** is connected on it's lower end to the downhole motor **40**. Shear screws **166** keeping the pulling sleeve **171** and the first mandrel **169** temporarily connected. Shear screws **171** do not transmit operational drilling loads. The stop sleeve **174** prevents the locking splines **162** from retracting. The inner and outer string are sealed against each other by means of high pressure seals **163** and **176**.

[0021] When fishing the drilling liner inner string, the fishing string (not shown) is tripped in and connected to the pulling sleeve **171**. The make up torque when applied is transmitted from the pulling sleeve **171** via a toothed connection to the first mandrel **169**. When the fishing string is pulled, the shear screws **166** break, and the pulling sleeve **171** will move upwards until the stop sleeve **174** shoulders against the first mandrel **169**. The seal carrier **168** build up a chamber to allow the locking splines **162** to retract. The locking splines **162** have inclined shoulders which generate a radial load on to the locking splines **162** when pulled. Continued pulling on the fishing string causes the locking splines **162** to retract. After the locking splines **162** are fully retracted, the inner string is disconnected from the outer string. The drilling liner can now be pulled out of hole along with the motor and the pilot bit. During the process of disconnection, mud circulates from the upper bypass port **172** into the inner string and out through the opened bypass port **167** of the first Mandrel **169**. This reduces the surge and suction pressures.

[0022] The embodiment of **FIGS 3** and **4** has a number of advantages over the embodiment of **FIGS. 1-2**. The trip time may be reduced in certain applications. When no thruster is used, the bottom hole assembly does not have any additional hydraulic components. The bottom hole assembly can be preassembled and the spacings checked out before delivery to the rig site. A standard mud motor can be used without any special bearings. The total hook load is less by the amount of weight of the inner string. There is less of a pressure drop because the mud is not passing through the small inner string. Kick control might be improved in some ap-

plications when tripping in the inner string.

[0023] **FIGS. 5A** shows an embodiment of a steerable Drilling Liner system with a steerable drilling liner. Shown is a rig **212** at the surface **208** of the earth. A casing **214** has been set in the upper portion of the borehole. A drilling tubular **216** passes through the casing to a liner hanger **218** at the bottom of the cased portion of the hole and carries a drilling liner - bottom hole assembly (DL-BHA) **222** at its lower end. The DL-BHA has, at its bottom end, a pilot bit **26** and a core bit **24**. A liner **20** hangs from the liner hanger **18** at its top end is connected to the DL-BHA at its bottom end. These are as discussed above with reference to **FIG. 1**. The lower portion of the system has an MWD assembly **230** with a non-magnetic liner **232**. The MWD assembly **230** offers directional control and can also provide information about the formation being traversed by it. This could include density, resistivity, gamma ray, NMR etc. measurements. The inner DL-BHA assembly **222** includes a flex shaft **234** between the motor and the male sub **254** and core bit **226**. A radial bearing **256** supports the female sub **250** on the male sub **254** The liner **220** has a bent sub **236** that can be a fixed bend or an Adjustable Kick Off / bend Sub (AKO) making it possible to steer the liner under control of measurements from the MWD assembly **230**. This device may also be used without an inner string between the DL-BHA and the liner hangers, similar to the arrangement discussed above with reference to **FIG. 3**.

[0024] **FIG. 5B** shows a steerable Drilling Liner system that differs from the system shown in **FIG. 5A** in that the motor **322**, MWD device **330** and optional LWD (logging while drilling) are extending out of the core bit **324**. The inner string is centralized inside the liner via stabilizers. There is no non-magnetic liner required. Instead of the flex shaft, male sub and pilot bit a standard stabilized motor **322** (motor stabilization is not shown) with AKO sub **336** and standard drill bit **326** is used on bottom of the inner string. With the MWD / LWD assembly placed in the open hole, full service of geosteering is possible. Geosteering (density, resistivity, gamma ray, NMR etc. measurements) is used to steer along or in between formation boundaries.

[0025] Another arrangement of a steerable Drilling Liner system is shown in **FIG. 6**. Shown is a rig **412** at the surface **410** of the earth. A casing **414** has been set in the upper portion of the borehole. A drilling tubular **416** passes through the casing to a liner hanger **418** at the bottom of the cased portion of the hole and carries a drilling liner - bottom hole assembly (DL-BHA) **422** at its lower end. The DL-BHA has, at its bottom end, a pilot bit **426** and a core bit **424** A liner **420** hangs from the liner hanger **418** its top end is connected to the DL-BHA at its bottom end. These are as discussed above with reference to **FIG. 1**. The lower portion of the system has an MWD assembly **430** with a non-magnetic liner **432** The MWD assembly **430** offers directional control and can also provide information about the formation being traversed by it. This could include density, resistivity, gamma ray, NMR etc. measurements. The liner **420** can be steered downhole in inclination and azimuth by a steering system featuring retractable and expandable pads **438**. In one embodiment of the invention, the pads **438** are on a non-rotatable sleeve. The liner is rotated within the sleeve whilst the sleeve is non-rotating. The sleeve itself features three or more pads which will be are loaded (expanded) or unloaded (retracted) to push the liner in the desired direction. The use of such a non-rotatable sleeve is would be known to those versed in the art. A commercial embodiment of this is the AUTOTRAK ™ system of Baker Hughes and is not discussed further. An alternative is to use pads within the drilling liner. This device may also be used without an inner string between the DL-BHA and the liner hangers, similar to the arrangement discussed above with reference to **FIG. 3**.

[0026] An alternate embodiment of the device shown in **FIG. 6** uses an expandable stabilizer located at a suitable position **438** on the BHA (the position can vary depending on the application and needs). With such an arrangement, the expandable stabilizer serves as a pivot point enabling steering of the assembly. The use of such an expandable stabilizer would be known to those versed in the art and is not discussed further.

[0027] **FIG. 7** shows an embodiment of the invention using two additional packers. Shown is a rig **512** at the surface **510** of the earth in which a borehole **508** is drilled. A casing **514** has been set in the upper portion of the borehole. A drilling tubular **516** passes through the casing to a liner hanger **518** at the bottom of the cased portion of the hole and carries a drilling liner - bottom hole assembly (DL-BHA) **522** at its lower end. The DL-BHA has, at its bottom end, a pilot bit **526** and a core bit **524** A liner **520** hangs from the liner hanger **518** its top end is connected to the DL-BHA at its bottom end. These are as discussed above with reference to **FIG. 1**. Two additional packers are provided. One is a casing packer **552** just below the liner hanger **518**. The other is an open hole packer **556** located close to the bit. The mud circulates in the direction indicated by **560**, i.e., down the inner liner, out near the drill bit, back into the outer liner **520** through a port **554**, through the annulus between the inner liner and the outer liner **520**. The advantage of this invention is that there is no mud circulating in the annulus **550** between the outer liner **520** and the borehole **508**, so that the open hole is not affected by the dynamic pressure of the circulated mud system. This reduces the contamination of the formation by the circulating mud.

[0028] This device may also be used with the steering arrangement (**FIG. 5A**, **5B** above) and with steerable pads (**FIG. 6** above).

[0029] **FIG. 8** shows an arrangement using an underreamer on the outside of the outer casing. Shown is a rig **612** at the surface **610** of the earth. A casing **614** has been set in the upper portion of the borehole. A drilling

tubular **616** passes through the casing to a liner hanger **618** at the bottom of the cased portion of the hole and carries a drilling liner - bottom hole assembly (DL-BHA) **622** at its lower end. The DL-BHA has, at its bottom end, a pilot bit **626** and a core bit **624** A liner **620** hangs from the liner hanger **618** at its top end is connected to the DL-BHA at its bottom end. These are as discussed above with reference to **FIG. 1**. The under-reamer **630** is placed in the lower outer part of the liner **620**. With the use of the under-reamer to enlarge the hole drilled by the core bit, it is possible to overcome slip-stick or differential sticking problems or to run an expandable casing. This device may also be used without the inner string (**FIG. 3** above), with the steering arrangement (**FIG. 5A, 5B** above) and with steerable pads (**FIG. 6** above).

[0030] **FIG. 9** illustrates another embodiment of the invention. Shown is a rig **712** at the surface **710** of the earth. A casing **714** has been set in the upper portion of the borehole. A drilling tubular **716** passes through the casing to a liner hanger **718** at the bottom of the cased portion of the hole and carries a drilling liner - bottom hole assembly (DL-BHA) **722** at its lower end. The DL-BHA has, at its bottom end, a pilot bit **726** and a core bit **724**. A liner **720** hangs from the liner hanger **726** at its top end is connected to the DL-BHA at its bottom end. These are as discussed above with reference to **FIG. 1**. The core bit **724** is expandable, ad indicated by the arrows **730**. This makes it possible to expand the hole, making it possible to overcome stick-slip or differential sticking problems as well as to run an expandable casing. Alternatively, the pilot bit **726** may be made expandable, in which case, the core bit **724** is not necessary and the male sub with drive splines will not be required. The inner string may then be guided in a radial direction by means of stabilizer pads (not shown). This device may also be used without the inner liner (**FIG. 3** above), with the steering arrangement (**FIG. 5A, 5B** above), with steerable pads (**FIG. 6** above) and with an under reamer (**FIG. 7** above).

[0031] The invention discussed above with respect to **FIGS. 1, 3, 5, 6** and **7** above may also be used with the use of a pilot bit including high pressure jet nozzles (not shown). The high fluid velocity exiting the nozzles washes the formation away to enlarge the hole size. The use of high pressure nozzles to wash out the formation would be known to those versed in the art and is not discussed further. With the use of such a special pilot bit, it is possible to overcome stick-slip or differential sticking problems as well as to run an expandable casing. In addition, with MWD measurements, the well may be deviated in a desired direction by the use of jet nozzles. This requires a system that allows mud flow through the nozzles in only one direction.

[0032] There are instances in the drilling of unusually pressured formations when the upper part of the outer liner gets stuck. In such instances, **FIG. 10** provides a schematic illustration of a DL- BHA **822** where drilling may be continued with the drilling liner. To accomplish this, the inner portion of the DL-BHA has an additional thruster, referred to as the bottom thruster **869**. The main parts of the bottom thruster are the cylinder **870**, the position indicator **871**, the piston **872** and the spline area **873**. The main portions of the drilling motor **859** are indicated as : the landing splines **860**, the bearing section **862** and the drive sub **864**. The suspension sub has an inner and outer portion, labeled as **848b** and **848a** respectively. As in the device disclosed in **FIG. 1**, the male sub **854** is provided with drive splines **850** that engage the female sub **850**. The pilot bit **824** is surrounded by the core bit **826** as in the other embodiments of the invention. The landing sub **844** couples the motor **859** to the suspension sub **848a**, **848b**.

[0033] Under normal drilling conditions, the core bit **826** is at the bottom of the hole at the same depth as the pilot bit **824**. The bottom thruster is completely closed and the inner portion of the suspension sub **848b** is fully telescoped inside the outer part **848a**. of the suspension sub. If it some point the outer liner (not shown in **FIG. 9**) gets stuck at some point at or above the motor **859**, the bottom thruster **869** is used to push the pilot bit **824** and the core bit **826** to continue drilling further into the formation until the thruster is fully extended. In such a system, the female **850** and male sub **854** are elongated by the stroke length of the bottom thruster **869** over what would normally be needed.

Claims

1. A drilling liner system for use in continued drilling of a borehole having a casing therein, the casing having a drilling tubular inside and a liner hanger/packer assembly at the bottom, the drilling liner system comprising:

    (a) a tubular coupled to the drilling tubular and to an inner bottom hole assembly, the inner bottom hole assembly including:

        (i) a drilling motor coupled to the tubular and adapted to be operated by mud conveyed by said tubular; and
        (ii) a drive shaft on the drilling motor coupled to a male sub with retractable drive splines thereon, the male sub coupled to a pilot bit for drilling a pilot hole upon operation of the drilling motor; and

    (b) a liner coupled at a first end to the liner hanger/packer and at a second end to an outer bottom hole assembly, the outer bottom hole assembly including:

        (i) a female sub adapted to engage drive splines on the male sub and rotate with the

male sub upon being engaged thereto, and
(ii) a core bit surrounding the pilot bit and coupled to the female sub for drilling an enlarged hole.

2. The drilling liner system of claim 1 further comprising a landing sub with splines thereon for ensuring proper alignment of the inner bottom hole assembly and the outer bottom hole assembly.

3. The drilling liner system of claim 1 further comprising a suspension and bearing sub for providing longitudinal length suspension and radial guidance and isolating the rotation of the female sub from the liner.

4. A drilling liner system for use in continued drilling of a borehole having a casing therein, the casing having a drilling tubular and a liner hanger/packer assembly at the bottom, the drilling liner system comprising:

(a) an inner bottom hole assembly including:

(i) a drilling motor adapted to be operated by mud conveyed downhole by the drilling tubular; and
(ii) a drive shaft on the drilling motor coupled to a male sub with retractable drive splines thereon, the male sub coupled to a pilot bit for drilling a pilot hole upon operation of the drilling motor;

(b) a liner coupled at a first end to the liner hanger/packer and the drilling tubular, and at a second end to an outer bottom hole assembly, the outer bottom hole assembly including :

(i) a female sub adapted to engage the drive splines on the male sub and rotate with the male sub upon being engaged thereto, and
(ii) a core bit surrounding the pilot bit and coupled to the female sub for drilling an enlarged hole; and

(c) a releasing tool for releasably coupling the inner bottom hole assembly to the liner.

5. The drilling liner system of claim 4 further comprising a fishable joint on the releasing tool for facilitating retrieval of the inner bottom hole assembly from the borehole.

6. The drilling liner system of claim 1 further comprising an MWD device having a non-magnetic liner in the tubular for providing directional measurements, and devices to facilitate directional drilling on the inner bottom hole assembly and the outer bottom hole assembly.

7. The drilling liner system of claim 6 wherein the devices to facilitate directional drilling further comprise

(I) a flex shaft between the motor and the male sub, and,
(II) a bent sub on the outer bottom hole assembly above the female sub, said bent sub selected from (i) an AKO, and (ii) a fixed angle.

8. The drilling liner system of claim 4 further comprising an MWD device in the inner bottom hole assembly to provide directional measurements and devices on the inner and outer bottom hole assemblies to facilitate directional drilling.

9. The drilling system of claim 1 further comprising an MWD device in the inner bottom hole assembly to provide directional measurements, and a plurality of retractable pads on the outside of the outer bottom hole assembly, said retractable pads adapted to engage the borehole wall and guide the drilling system in a desired direction in inclination and azimuth.

10. The drilling system of claim 4 further comprising an MWD device in the inner bottom hole assembly to provide directional measurements, and a plurality of retractable pads on the outside of the outer bottom hole assembly, said retractable pads adapted to engage the borehole wall and guide the drilling system in a desired direction in inclination and azimuth.

11. The drilling system of claim 1 further comprising a casing packer located below the liner hanger/packer and an open hole packer located close to the core bit, said casing packer and open hole packer preventing the flow of drilling fluids into an annulus between the liner and the borehole.

12. The drilling system of claim 4 further comprising a casing packer located below the liner hanger/packer and an open hole packer located close to the core bit, said casing packer and open hole packer preventing the flow of drilling fluids into an annulus between the liner and the borehole.

13. The drilling system of claim 6 further comprising a casing packer located below the liner hanger/packer and an open hole packer located close to the core bit, said casing packer and open hole packer preventing the flow of drilling fluids into an annulus between the liner and the borehole.

14. The drilling system of claim 9 further comprising a

casing packer located below the liner hanger/packer and an open hole packer located close to the core bit, said casing packer and open hole packer preventing the flow of drilling fluids into an annulus between the liner and the borehole.

15. The drilling system of claim 1 further comprising a reamer on the outside of the outer bottom hole assembly, said reamer adapted to enlarge the hole drilled by the core bit.

16. The drilling system of claim 4 further comprising a reamer on the outside of the outer bottom hole assembly, said reamer adapted to enlarge the hole drilled by the core bit.

17. The drilling system of claim 1 wherein at least one of (i) the core bit, and (ii) the pilot bit is expandable.

18. The drilling system of claim 4 wherein at least one of (i) the core bit, and (ii) the pilot bit is expandable.

19. The drilling system of claim 1 wherein the pilot bit further comprises high pressure jetting nozzles.

20. The drilling system of claim 4 wherein the pilot bit further comprises high pressure jetting nozzles.

21. A drilling liner system for use in continued drilling of a borehole having a casing therein, a drilling tubular inside the casing, and a liner hanger/packer assembly at the bottom of the casing, the drilling liner system comprising:

(a) a tubular coupled to the drilling tubular and to an inner bottom hole assembly, the inner bottom hole assembly including:

(i) a drilling motor coupled to the tubular and adapted to be operated by mud carried by said tubular;
(ii) a thruster coupled to a drive shaft on the drilling motor and to a male sub, the thruster adapted to extend and retract the position of the male sub relative to the drilling motor
(iii) retractable drive splines on the male sub, and
(iv) a pilot bit coupled to the male sub for drilling a pilot hole upon operation of the drilling motor; and

(b) a liner coupled at a first end to the liner hanger/packer and at a second end to an outer bottom hole assembly, the outer bottom hole assembly including:

(i) a female sub adapted to engage drive splines on the male sub and rotate with the male sub upon being engaged thereto,
(ii) a core bit surrounding the pilot bit and coupled to the female sub for drilling an enlarged hole, and
(iii) a telescopic suspension sub coupled to the drilling motor and the female sub, said telescopic sub adapted to move the female sub in conjunction with the motion of the thruster.

22. The drilling liner system of claim 1 wherein the drilling tubular is selected from the group consisting of (i) a drill pipe, and (ii) coiled tubing.

23. The drilling liner system of claim 4 wherein the drilling tubular is selected from the group consisting of (i) a drill pipe, and (ii) coiled tubing.

24. A method of drilling a borehole comprising:

(a) setting a casing in a section of the borehole;
(b) passing a drilling tubular through the casing and a liner hanger/packer assembly at the bottom of the casing;
(c) operating a drilling motor coupled to a lower end of the tubular by passing mud carried by said tubular;
(d) coupling a first end of a liner to the liner hanger/packer and at a second end to an outer bottom hole assembly;
(e) coupling a drive shaft on the drilling motor to a male sub with retractable drive splines thereon and to a pilot bit for drilling a pilot hole upon operation of the drilling motor;
(f) engaging a female sub on the outer bottom hole assembly to the drive splines on the male sub and rotating with the male sub upon being engaged thereto, thereby operating a core bit on the outer bottom hole assembly for drilling an enlarged hole.

25. A method of drilling a borehole comprising:

(a) setting a casing in a section of the borehole;
(b) coupling a first end of a liner to a liner hanger/packer at the bottom of the casing;
(c) coupling a second end of the liner to an outer bottom hole assembly having a core bit thereon;
(d) using a releasing tool to couple the outer bottom hole assembly to an inner bottom hole assembly having a mud motor therein;
(e) coupling a drive shaft on the drilling motor to a male sub with retractable drive splines thereon and to a pilot bit for drilling a pilot hole upon operation of the drilling motor;
(f) engaging a female sub on the outer bottom

hole assembly to the drive splines on the male sub thereby enabling the core bit to drill an enlarged hole upon operation of the drilling motor;
(g) conveying mud through a drilling tubular in the casing through the liner hanger/packer into the liner and using the mud to operate the drilling motor, thereby causing the pilot bit to drill a pilot hole and the core bit to drill an enlarged hole.

26. The method of claim 25 further comprising operating the releasing tool to decouple the inner bottom hole assembly from the outer bottom hole assembly, and using a fishing hook on the inner bottom hole assembly to retrieve the inner bottom hole assembly from the borehole.

27. The method of claim 24 further comprising using an MWD device in the tubular for providing directional measurements, and using such directional information on devices on the inner bottom hole assembly and the outer bottom hole assembly for directional drilling.

28. The method of claim 24 further comprising using an MWD device in the inner bottom hole assembly to provide directional measurements, and using a plurality of retractable pads on the outside of the outer bottom hole assembly to engage the borehole wall and guide the pilot bit and the core bit in a desired direction in inclination and azimuth.

29. The method of claim 24 further comprising using a casing packer located below the liner hanger/packer and an open hole packer located close to the core bit for preventing the flow of drilling fluids into an annulus between the liner and the borehole.

30. The method of claim 24 further comprising a using reamer on the outside of the outer bottom hole assembly, said reamer adapted to enlarge the hole drilled by the core bit.

31. The method of claim 24 wherein at least one of (i) the core bit, and (ii) the pilot bit is expandable.

32. The method of claim 24, further comprising using high pressure jetting nozzles on the core bit to facilitate drilling.

33. The method of claim 24, further comprising using a thruster on the inner bottom hole assembly to move the male sub relative to the drilling motor and using a telescopic suspension sub on the outer bottom hole assembly to maintain engagement between the female sub and the drive splines on the male sub.

34. A drilling liner system, comprising:

an inner string carrying an inner assembly having a pilot bit (26); and
an outer assembly having a core bit (24);
wherein, in use, both said assemblies are temporarily connected to one another using retractable splines.

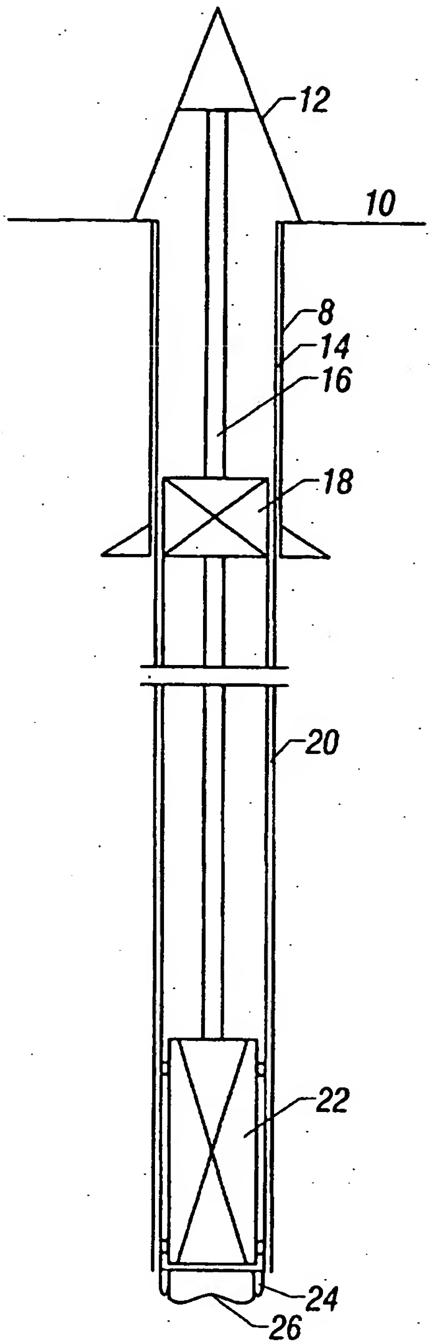

FIG. 1

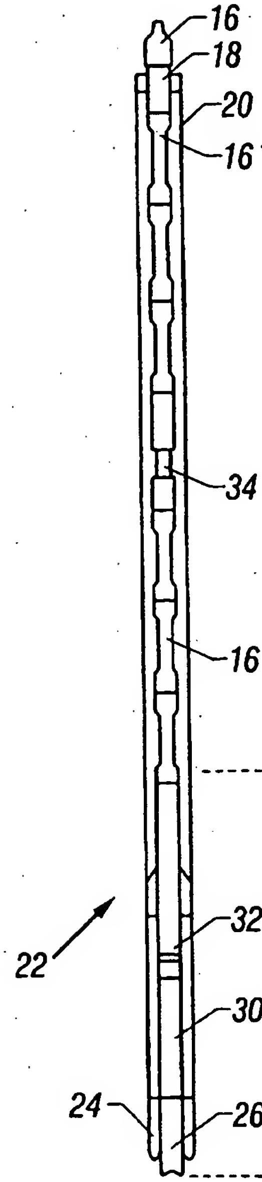

FIG. 2A

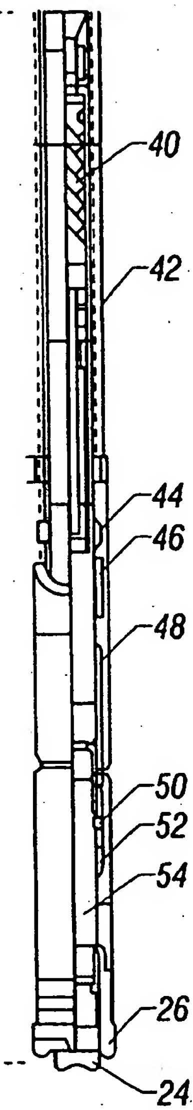

FIG. 2B

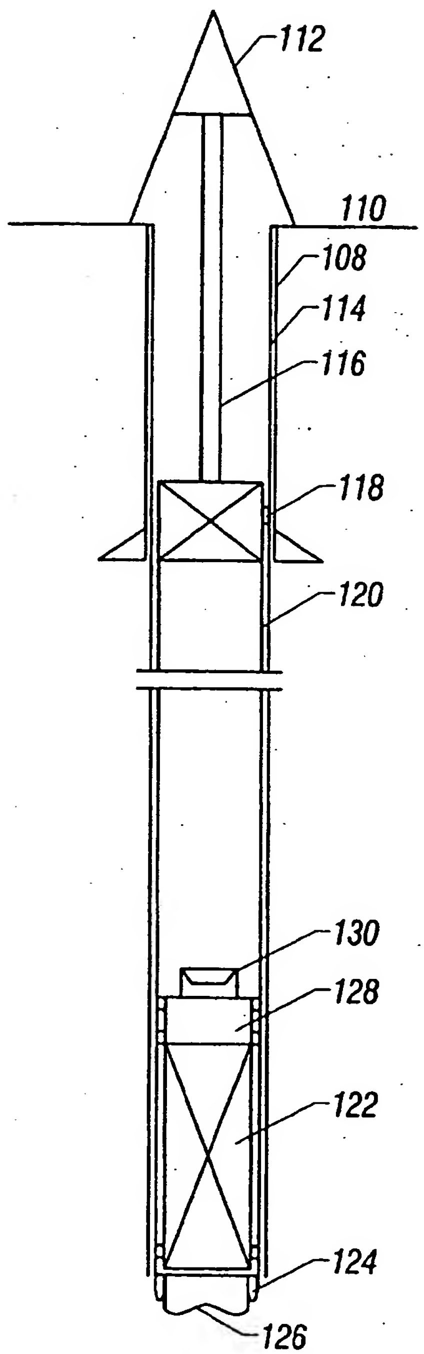

FIG. 3

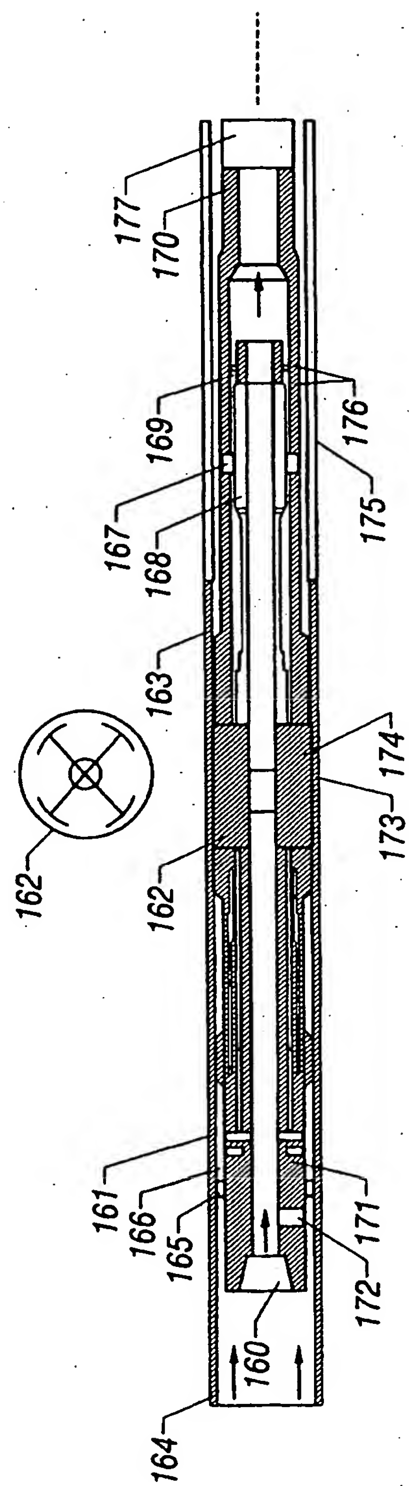
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FIG. 4a

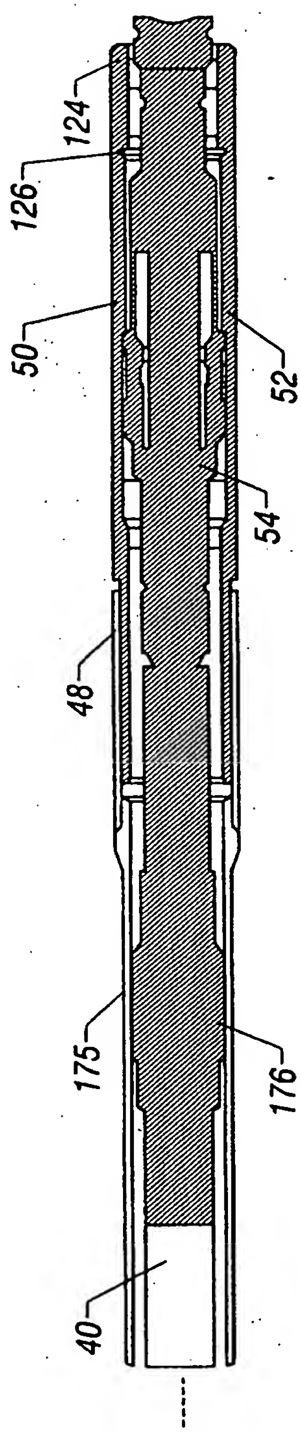
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FIG. 4b

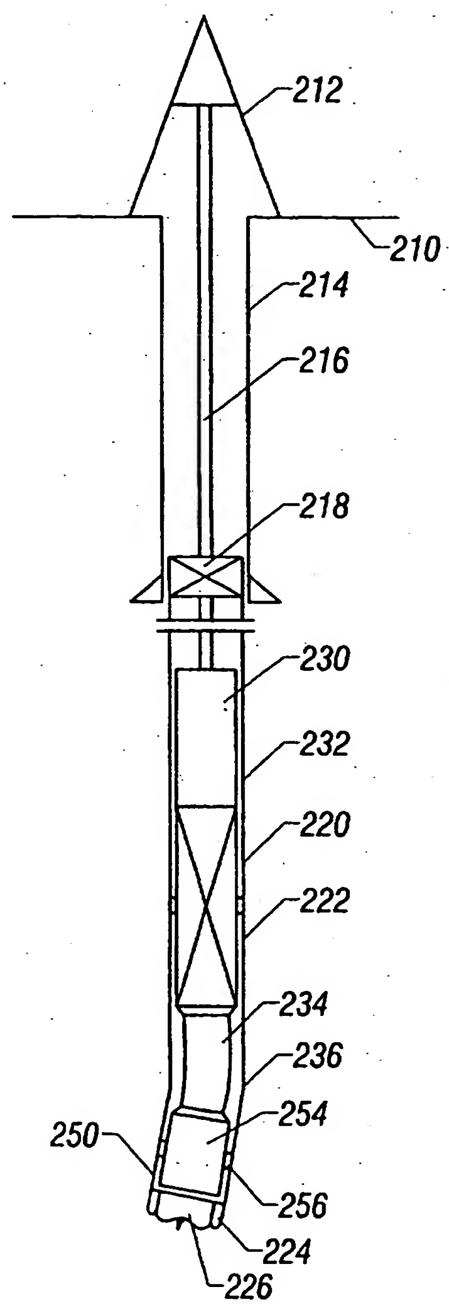
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FIG. 5A

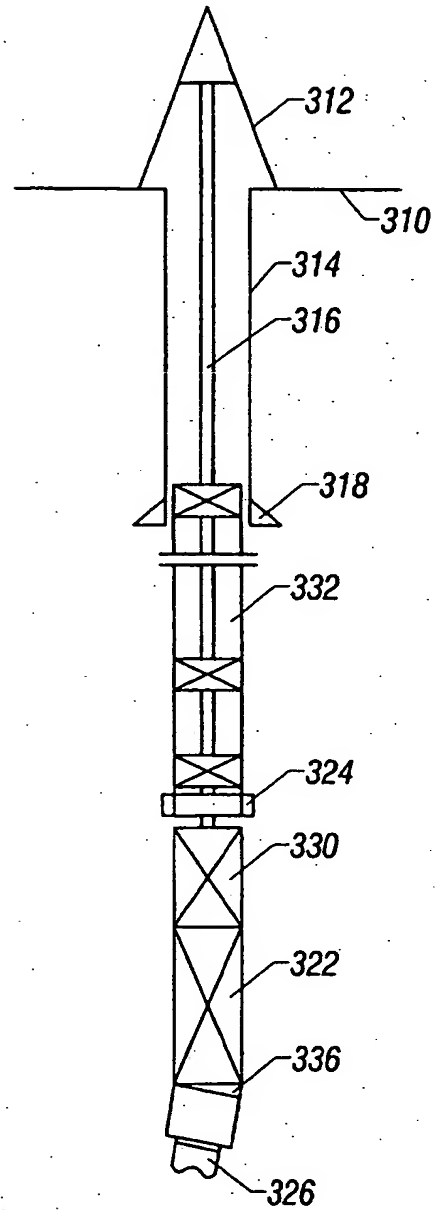
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FIG. 5B

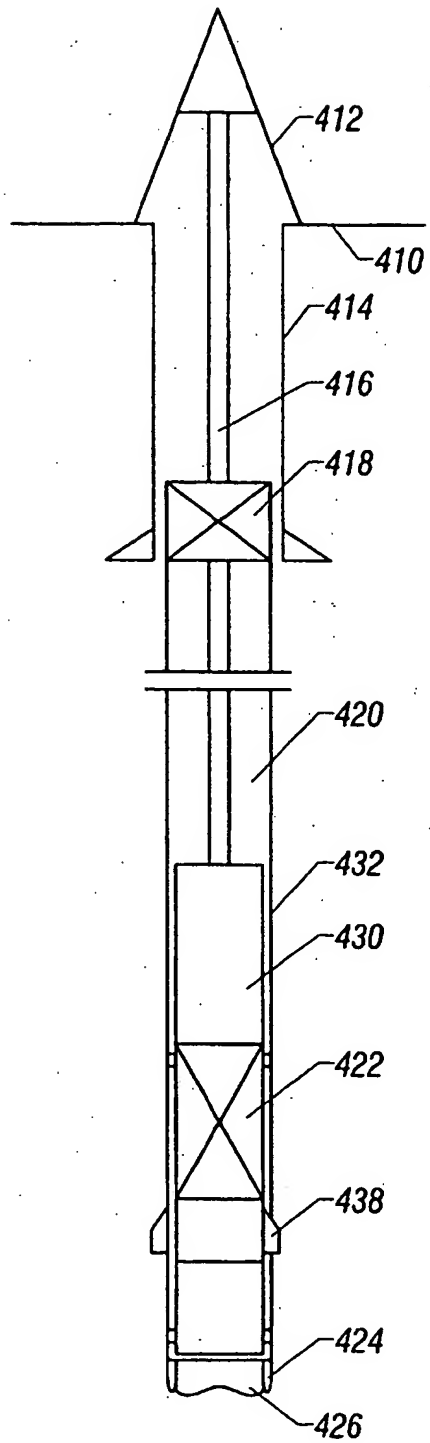

FIG. 6

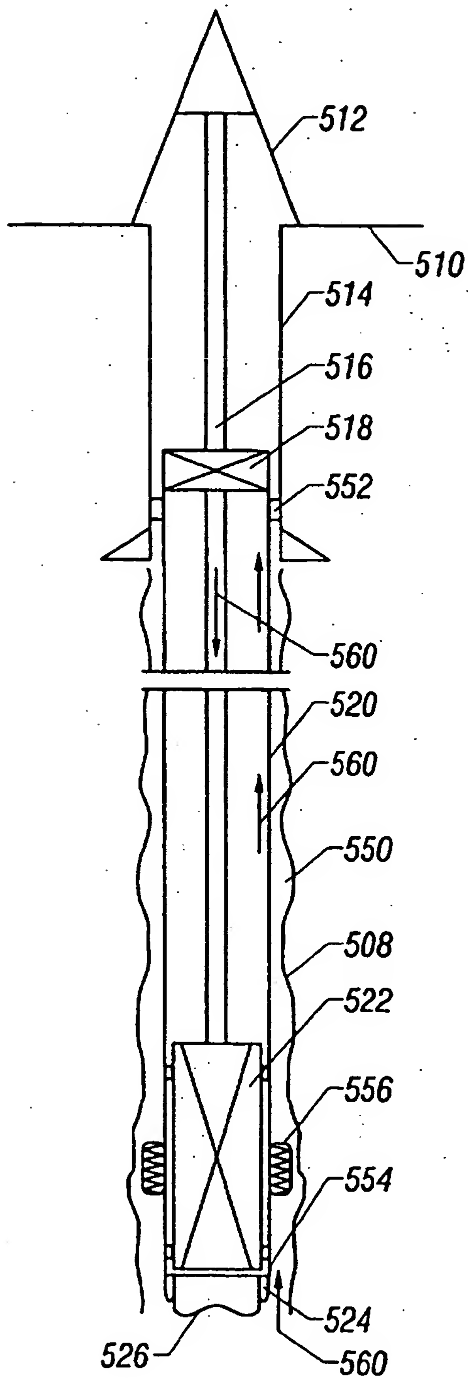
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FIG. 7

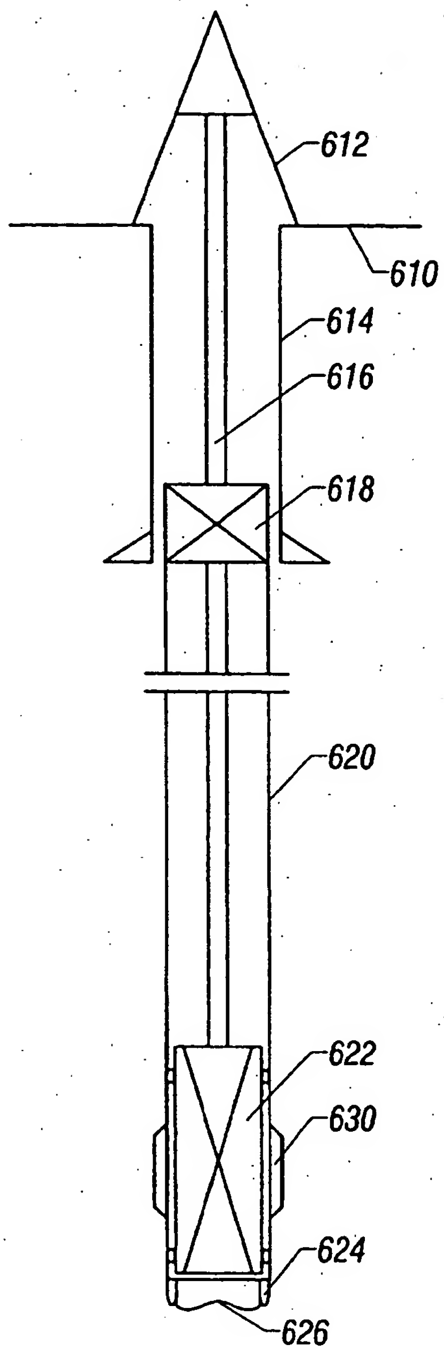

FIG. 8

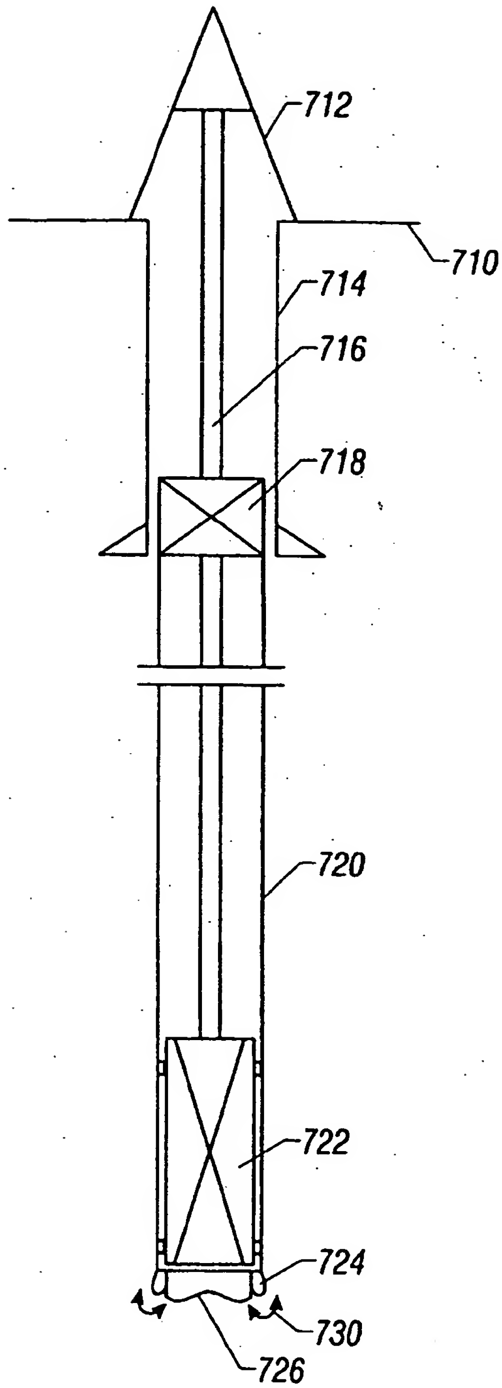

FIG. 9

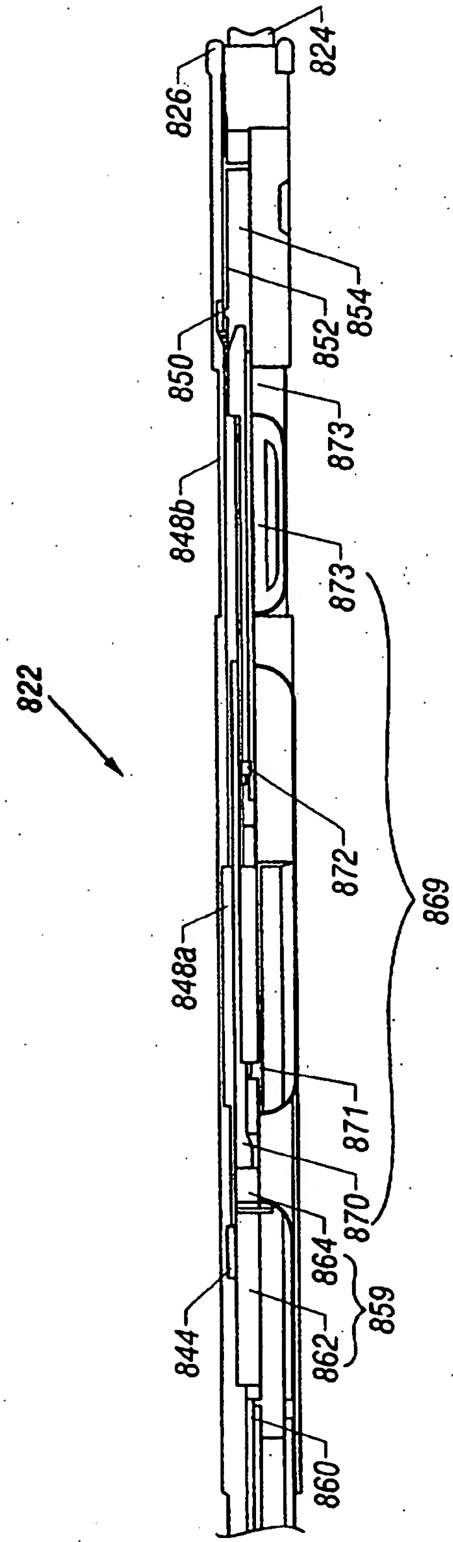
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FIG. 10